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ITEM OF INTEREST

Prepared by

Aerospace Information Division

SUBJECT: Seismic Waves Originating in the Subcrustal Layer

SOURCE: Vol'vovskiy, B. S., I. S. Vol'vovskiy, and V. Z. Ryaboy. Some data on seismic waves originating in the subcrustal layer. IN: Moscow. Vsesoyuznyy nauchno-issledovatel'skiy institut geofizicheskikh metodov razvedki. Prikladnaya geofizika, no. 31, 1961. 3-10. (S/552/61/000/031)

The Uzbek Geophysical Trust, in cooperation with the All-Union Scientific Research Institute for Geophysical Exploration Methods, conducted regional seismic studies of the structure of the earth's crust in the Fergana Valley and the Bukhara-Khiva oil- and gas-bearing province during 1958-1959 (see Fig. 1). Schematic cross sections of the earth's crust for sectors of the areas studied are shown in Fig. 2.

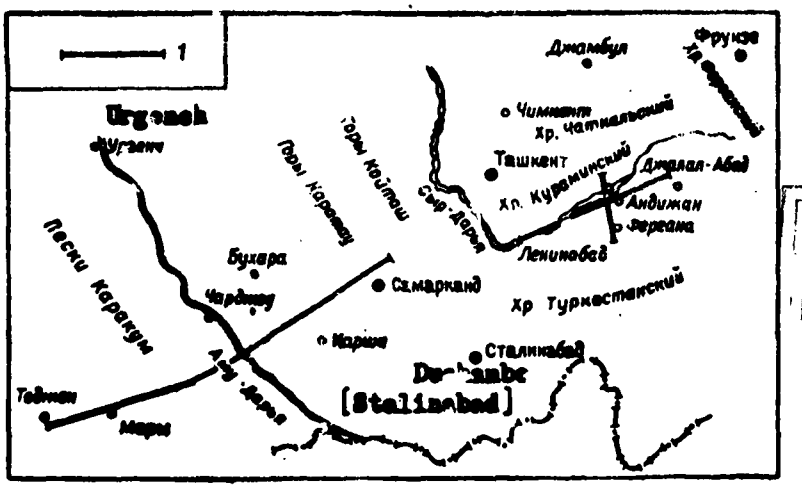

Fig. 1. Location of deep seismic logging profiles

Seismic observations were carried out with correlated direct-crossing and overtaking time-distance curves whereby the reflected waves were recorded simultaneously. Seismic vibrations were recorded by ПСС-60 low-frequency seismic stations. The groups of seismographs, each consisting of four detecting instruments, were placed 100 m from each other. Shot points

were laid out in profile at distances of 15 to 20 km for studying the subsurface structure of the earth's crust. Shots were placed in rivers, ponds, pits, and wells. The maximum distance between shot points and detectors was 200 km in the Fergana Valley and 300 km in the Bukhara-Khiva province. The average explosive charge was 1 to 2 tons.

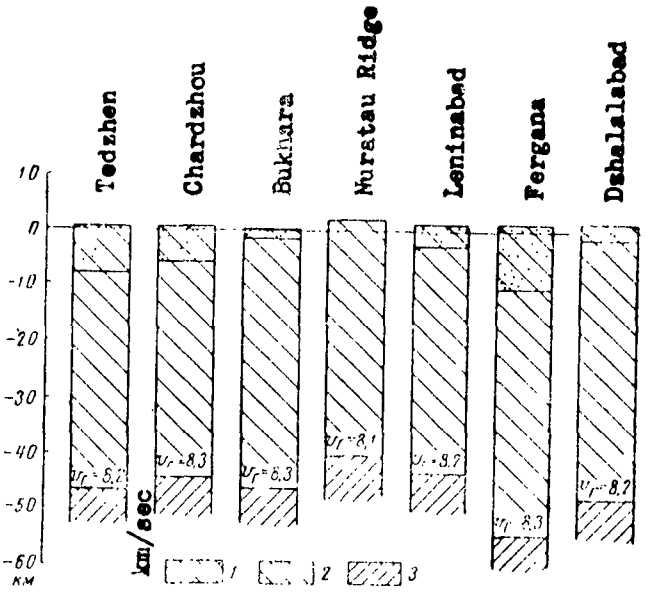

Fig. 2. Schematic cross sections of the earth's crust based on deep seismic logging

1 - sedimentary deposits; 2 - the earth's crust;
3 - subcrustal layer.

A large number of regular primarily longitudinal waves related to the interfaces in the sedimentary suprapaleozoic and crystalline beds of the earth's crust were recorded on seismograms. As to kinematic and dynamic properties, the recorded waves are of three types: 1) longitudinal refracted waves, recorded in the first and subsequent arrivals; 2) waves reflected from the deep interfaces of the earth's crust, recorded at short distances (up to 60 to 80 km) and long distances (up to 300 km) from the shot points; 3) various types of multiple reflected-refracted and transformed waves connected with deep interfaces. This last group also includes waves with low apparent velocities (less than 4 km/sec).

The following groups of waves, all belonging to type 1, were interpreted: refracted (head) waves, corresponding to the boundries in sedimentary rocks (P_{kMz}); base surface (P_z); and "granite" (P^o), "basalt" (P*), and subcrustal (P_{refr}) layers. Figs. 3 and 4 show the observed time-distance curves determined with deep seismic logging in the Bukhara-Khiva province.

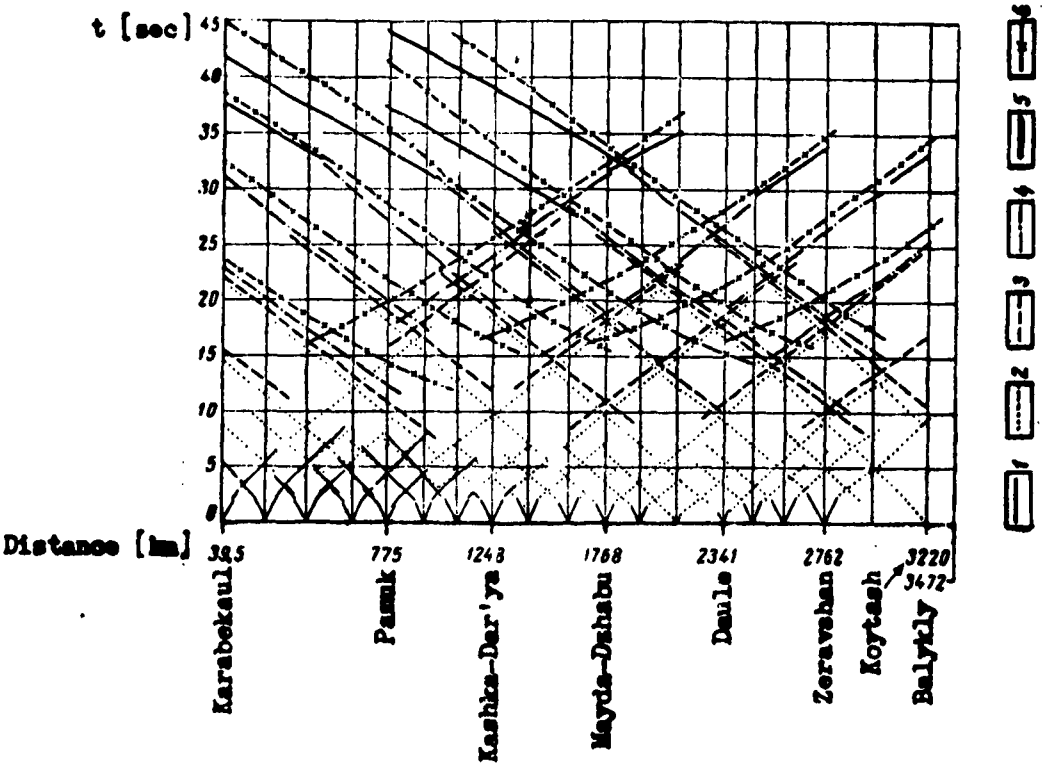

Fig. 3. The system of observed (schematic) time-distance curves determined with deep logging: Profile Amu-Dar'ya (Karabekaul)-- Nurabau (Kuytash), the Bukhara-Khiva oil- and gas-bearing province.

1 - time-distance curves of P_{kMz} waves; 2 - P_z waves; 3 - P^o waves; 4 - P* waves; 5 - P_{refr} waves; 6 - P_{refl} waves.

The apparent velocities of the refracted waves range from 1.8 to 5.7 km/sec within the P_{kMz} group; from 5.8 to 6.2 km/sec within the P_z group; from 6.3 to 7.5 within the P^o group; from 6.5 to 8.0 within the P* group; and from 8.0 to 9.5 within the P_{refr} group. Visible frequencies of these waves range between 10 and 16 cps. The "precritical" waves reflected from the deep interface boundaries of the earth's crust were recorded at a distance of 30 to 80 km from the shot point.

The latest theoretical and experimental investigations have shed new light on the physical nature of recorded waves. Calculations based on the dynamic theory of distribution of seismic vibrations, developed by G.I. Petrashen', A.S. Alekseyev, and others of the Leningrad Branch of the Institute of Mathematics, Academy of Sciences USSR, have revealed that in single-layered media, the strongest waves are those reflected beyond the critical angle rather than the head waves. In the case of gradient environments, the predominant waves are the reflected and refracted waves.

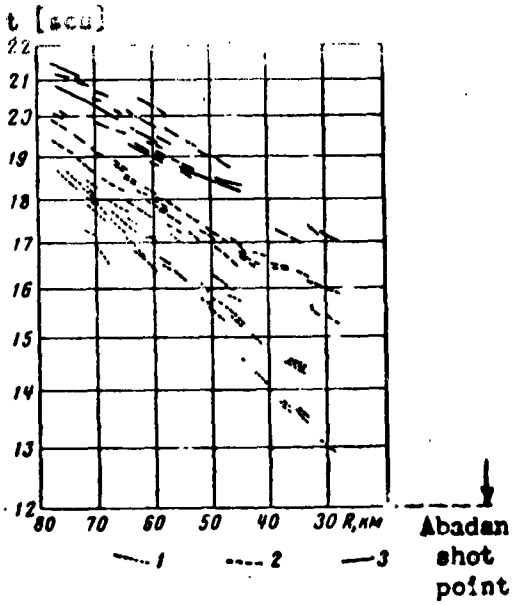

Fig. 4. Time-distance curves of waves reflected from the surface of the "granite" (1), "basalt" (2), and subcrustal (3) layers. The Fergana intermontane depression